

# **NAVAL POSTGRADUATE SCHOOL**

## **Monterey, California**



## **THESIS**

**AN ANALYSIS OF THE REQUISITION PROCESS AND  
READINESS FOR F/A-18E/F INTEGRATED READINESS  
SUPPORT TEAM (FIRST) PROGRAM**

by

Daniel J. Noll  
and  
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December 2002

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F/A-18E/F INTEGRATED READINESS SUPPORT TEAM (FIRST) PROGRAM**

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## **ABSTRACT**

Naval Aviation is beginning a transformation into a new era of logistics support. The beginning of a U.S. Navy/Industry teaming effort started with the U.S. Navy's F/A-18 E/F program. The new aircraft is supported through both standard military logistics programs and a brand new commercial logistics application known as F/A-18 E/F Integrated Readiness Support Teaming (FIRST). The non-traditional contract with Boeing is intended to outsource some maintenance, supply and inventory control for the new aircraft onto Boeing. The intended benefits behind the new concept include reduced costs, increased supply responsiveness and greater efficiency through commercial logistics applications. Promising increased aircraft readiness and seamless implementation, both Boeing and U.S. Navy representatives have great expectations for the new system.

Our research investigates the impact FIRST is having on F/A-18 E/F Operational Availability (Ao) through an evaluation of Supply Response Times (SRT) and actual squadron Mission Capability Rates for the period of 01 April 2002 through 30 June 2002. Our results suggest that although repairable parts are currently delivered more quickly through the FIRST program, the contract measurement of SRT may not reflect any long-term improvements in F/A-18 E/F readiness.

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## LIST OF ACRONYMS

|         |  |
|---------|--|
| Ao      | Operational Availability                                   |
| ACC     | Aircraft Controlling Custodian                             |
| ADT     | Administrative Delay Time                                  |
| AE      | Age Exploration  |
| AIMD    | Aircraft Intermediate Maintenance Detachment or Department |
| ASD     | Aviation Support Division                                  |
| ATAC    | Advanced Trace-Ability and Control                         |
| AVCAL   | Aviation Consolidated Allowance List                       |
| AVDLR   | Aviation Depot Level Repairable                            |
| BCM     | Beyond Capability of Maintenance                           |
| BER     | Beyond Economic Repair                                     |
| CFA     | Cognizant Field Activity                                   |
| CFE     | Contractor Furnished Equipment                             |
| CMC     | Commandant of Marine Corps                                 |
| CNO     | Chief of Naval Operations                                  |
| COG     | Cognizant Item Manager Material Code                       |
| COMPL   | Completed  |
| CONUS   | Continental United States                                  |
| CV      | Fixed Wing Aircraft Carrier                                |
| D Level | Depot Level  |
| DAAS    | Defense Automated Addressing System                        |
| DLA     | Defense Logistics Agency                                   |
| DLR     | Depot Level Repairable                                     |
| DoD     | Department of Defense                                      |
| DTO     | Direct Turn Over   |
| ECP     | Engineering Change Proposal                                |
| EXREP   | Expeditious Repair   |
| FAD     | Force Activity Designator                                  |
| FCA     | Field Cognizant Activity                                   |
| FIRST   | F/A-18E/F Integrated Readiness Support Team                |
| FISC    | Fleet Industrial Supply Center                             |
| FLR     | Field Level Repairable                                     |
| FMC     | Fully Mission Capable                                      |
| GOLD    | Government On-Line Data                                    |
| HIT     | Hornet Industry Team                                       |
| HSC     | Hornet Support Center                                      |

|          |  |
|----------|--|
| I Level  | Intermediate Level   |
| ICM      | Inventory Control Management                                     |
| ICP      | Inventory Control Point  |
| IIS      | Integrated Information Systems                                   |
| IM       | Item Manager   |
| IMA      | Intermediate Maintenance Activity                                |
| IPG      | Issue Priority Group   |
| LDT      | Logistics Delay Time   |
| LORA     | Level of Repair Analysis   |
| LRT      | Logistics Response Time  |
| LSA      | Logistics Support Analysis                                       |
| LSAR     | Logistics Support Analysis Record                                |
| 3M       | Maintenance and Material Management                              |
| MAF      | Maintenance Action Form  |
| MC       | Mission Capable  |
| MCC      | Material Control Code  |
| MDU      | Material Delivery Unit   |
| MILSTRIP | Military Standard Requisition and Issues Procedures              |
| MIS      | Mission Information System                                       |
| MMTR     | Maintenance Man-hours To Repair                                  |
| MADT     | Mean Administration Delay Time                                   |
| MMDT     | Mean Maintenance Delay Time                                      |
| MLDT     | Mean Logistic Delay Time   |
| MOB      | Main Operating Base  |
| MRR      | Material Replacement Rate  |
| MSD      | Material Support Date  |
| MSRT     | Mean Supply Response Time  |
| MTBD     | Mean Time Between Demand   |
| MTBF     | Mean Time Between Failure  |
| MTBR     | Mean Time Between Removals                                       |
| MTBM     | Mean Time Between Maintenance                                    |
| MTTR     | Mean Time To Repair  |
| NADEP    | Naval Aviation Depot   |
| NALCOMIS | Naval Aviations Logistics Command Management Information Systems |
| NAMP     | Naval Aviation Maintenance Program                               |
| NAS      | Naval Air Station  |
| NASL     | Naval Air Station Lemoore  |
| NAVAIR   | Naval Air Systems Command  |
| NAVICP   | Naval Inventory Control Point                                    |
| NAVMTO   | Navy Material Transportation Office                              |

|         |   |
|---------|---|
| NAVSUP  | Naval Supply System Command                               |
| NMCS    | Not Mission Capable Supply                                |
| NRFI    | Not Ready For Issue                                       |
| NSN     | National Stock Number                                     |
| O-Level | Organizational Level                                      |
| OEM     | Original Equipment Manufacturer                           |
| OMA     | Organizational Maintenance Activity                       |
| PD      | Priority Designator                                       |
| PMC     | Partial Mission Capable                                   |
| PMCS    | Partial Mission Capable for Supply                        |
| PVS     | Prime Vendor Support                                      |
| RCM     | Reliability Centered Maintenance                          |
| R&M     | Reliability and Maintainability                           |
| RBL     | Reliability Based Logistics                               |
| RDD     | Required Delivery Date                                    |
| RFI     | Ready For Issue   |
| ROR     | Repair of Repairables                                     |
| SCM     | Supply Chain Management                                   |
| SE      | Support Equipment   |
| SHORCAL | Shore Consolidated Allowance List                         |
| SM&R    | Source Maintenance and Recoverability                     |
| SOW     | Statement Of Work   |
| SRT     | Supply Response Time                                      |
| SQL     | Standard Query Language                                   |
| SRA     | Shop Replacement Assembly                                 |
| SRF     | Structural Repair Facility                                |
| TAT     | Turn Around Time  |
| TAV     | Total Asset Visibility                                    |
| TBIM    | Trigger Based Item Management                             |
| TD      | Technical Directive                                       |
| TMS     | Type Model and Series                                     |
| TOC     | Total Ownership Cost                                      |
| TPM     | Technical Performance Measures                            |
| UADPS   | Uniform Automated Data Processing                         |
| UMMIPS  | Uniform Material Movement and Issue Performance Standards |
| UND     | Urgency of Need Designators                               |
| WRA     | Weapons Replacement Assembly                              |

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## **I. INTRODUCTION**

### **A. GENERAL**

Naval Aviation is beginning a transformation into a new era of logistics support. The beginning of a U.S. Navy/Industry teaming effort started with the U.S. Navy's F/A-18 E/F program. The new aircraft is supported through both standard military logistics programs and a brand new commercial logistics application known as F/A-18 E/F Integrated Readiness Support Teaming (FIRST). [Ref. 1] The non-traditional contract with Boeing is intended to outsource some maintenance, supply and inventory control for the new aircraft onto Boeing.

The intended benefits behind the new concept include reduced costs, increased supply responsiveness and greater efficiency through commercial logistics applications. Promising increased aircraft readiness and seamless implementation, both Boeing and U.S. Navy representatives have great expectations for the new system.

### **B. BACKGROUND**

The FIRST contract is a product of the U.S. Navy's need to drive down life cycle costs, reduce inventories and improve readiness. Boeing's proposal of a seamless transition, improved readiness and increased supply chain responsiveness for a lower cost than traditional weapons systems appeared to be a perfect solution.

The basic concept of FIRST is to eventually have Boeing become the Item Manager (IM) for F/A-18 E/F airframe specific items. Additionally, under FIRST, Boeing will provide maintenance and engineering design improvements. These improvements will be quicker and will hopefully be provided at a lower cost than previous systems. The initial implementation (success/failure) metrics for the program are based upon the contractor's ability to provide the support once they receive a requirement from the Navy.

### **C. OBJECTIVE**

This research will review the process of ordering, issuing and receiving components at the squadron level to include the interface between concerned parties in the process. It is the researchers' goal to map out the process and identify strengths and

weakness of FIRST implementation and its possible impact on aircraft readiness. Analyzing the process should identify good business practices and ways to sustain those practices, as well as identify poor business practices and ways to improve them to increase aircraft readiness.

The specific objectives of this analysis are as follows:

- Provide background on the Navy's FIRST Program
- Provide an in-depth review of the FIRST contract metrics
- Review and map out the process of requisition and component flow under the standard Navy system and the FIRST program at Naval Air Station Lemoore, CA
- Use the data collected to identify potential positive or negative impacts of FIRST on F/A-18 E/F readiness
- Provide recommendations based upon the data collected

#### **D. RESEARCH QUESTIONS**

##### **1. Primary Research Questions**

- How does the FIRST contract ordering model compare to the standard Navy model for squadrons ordering repairable components?
- Does the FIRST program provide improved Operational Availability (Ao) for F/A-18 E/F aircraft?

##### **2. Secondary Research Questions**

- What is the document and component process flow when a squadron orders a component through the standard Navy requisition system?
- What is the document and component process flow when a squadron orders a component through the FIRST requisition system?
- What are benefits/drawbacks of the FIRST system verses the standard Navy requisition process?
- What are the FIRST contract metrics for delivering repairable components?
- Is there a positive or negative impact on overall mission capability rates under the FIRST process?

#### **E. SCOPE AND METHODOLOGY**

The scope will include: (1) an in-depth review of the FIRST contract metrics; (2) an in-depth review of the requisition and component flow under FIRST and the standard or organic Navy system at Naval Air Station Lemoore, CA; (3) an evaluation of the

effectiveness of each process; (4) discussion of the outcomes of the process under FIRST at Naval Air Station Lemoore, CA; (5) recommendations for requisition processing under the FIRST contract.

The methodology used in this thesis research will consist of the following steps:

- A literature search of books, magazine articles, CD-ROM systems, and other library information resources
- A thorough review of FIRST and NASL requisition processes
- Evaluate the processes by collecting and comparing data on requisition delivery timeframes and aircraft readiness at the squadron level
- Discuss the outcomes and their impacts on readiness
- Prepare a summary of findings, conclusion and recommendations

## **F. ORGANIZATION OF STUDY**

### **I. Introduction**

- A. General
- B. Background
- C. Objective
- D. Research Questions
- E. Scope and Methodology
- F. Organization of Study

### **II. Background**

- A. Navy Supply System
- B. Naval Aviation Maintenance Program
- C. FIRST Contract
- D. Metrics
- E. Requisition of Repairables
- F. Chapter Summary

- III. Methodology
  - A. Introduction
  - B. Metric Analysis Tools
  - C. Chapter Summary
- IV. Data Analysis
  - A. Mapping the Process
  - B. Data Analysis
  - C. Chapter Summary
- V. Conclusions and Recommendations
  - A. Conclusions
  - B. Recommendations
  - C. Suggested Further Studies

## **II. BACKGROUND**

This chapter provides background on the Naval Supply System (organic), Naval Aviation Maintenance Program (organic) and the F/A-18 E/F FIRST contract (contractor). First, it will discuss Navy Supply System responsibilities to Naval Aviation; second, it will discuss maintenance responsibilities to Naval Aviation; third, it will discuss FIRST contractor responsibilities to Naval Aviation; and lastly, it will explain the basic process for requisitioning repairable components.

### **A. NAVY SUPPLY SYSTEM**

The Navy Supply System is under the direction of the Commander Naval Supply Systems, and consists of Inventory Control Points (NAVICPs) and Stock Points (SPs). They are charged with managing material through cognizant (COG) designation. Cognizance symbols are two digit alphanumeric codes prefixed to national stock numbers. The first character of the cognizance symbol identifies the stores account. Numbers 1, 3, 5 and 7 are for material in the Navy Stock Account. The second character is assigned according to material type and application.

Naval Inventory Control Point Philadelphia manages repairable material that, when unserviceable, can normally be economically repaired. They are responsible for 1R COG aeronautical, photographic, meteorological material, 7R aeronautical Depot Level Repairable Spares (DLRs), and contractor supported items that become 7R material once they are assigned to a stores account.

Repairables are grouped as Field Level Repairable (FLRs) or Depot Level Repairable (DLRs). The criteria used to categorize an item as FLR or DLR is based on the lowest level authorized to condemn or determine if the item is unserviceable. Most 1R COG material is designated as FLRs, and condemned and disposed of at the field level (squadron); however, some are designated as DLRs. All 7R COG materials are items that can be economically repaired at depot level. This thesis addresses 1R, 7R and contractor supported COG DLR material managed by NAVICP to support aviation customers. [Ref. 2]

To achieve greater customer support for operating aviation squadrons, additional supply activities are utilized. Otherwise known as Aviation Support Divisions (ASDs), these small support centers locally manage Depot Level Repairables (DLRs) for their respective aviation squadrons.

## 1. Navy Inventory Control Points

NAVICP is responsible for material support of the Naval Aviation Maintenance Program (NAMP). Aviation material consists of spare parts for aircraft, engines, avionics, electrical, accessories and safety equipment; Support Equipment (SE), common and peculiar; and aeronautical photographic and meteorological equipment. [Ref. 3] The NAVICP establishes special pools and fixed allowances for aviation material. Repairable assets (DLRs) under their cognizance are established and carried in Special Purpose Codes. Table 1 lists purpose codes and associated inventory levels assigned to DLRs by NAVICP. This thesis addresses Wholesale A, Consumer level A and W purpose SHORECAL fixed allowances. [Ref. 2]

2. PURPOSE CODES. Supplement information on purpose codes as provided. Inventories and fixed allowances ashore will be identified by purpose code. Separate visibility and storage locations for End-Use and wholesale (NWCF owned) inventories are required. Physical inventory reports must accommodate separate purpose code (A/V/W/L) visibility and ownership. The following purpose codes and the associated logistics assignments apply:

| <u>Purpose Code</u> | <u>Inventory Level</u>                                       | <u>Stores Account /Cog</u>                                   | <u>Remarks</u>   |
|---------------------|--|--|--|
| A                   | Wholesale  | NWCF/All<br>NWCF (incl. 0 cog) APA/All<br>APA                | - Pushed   |
| A                   | Intermediate Retail  | NWCF/All<br>NWCF APA/All<br>APA                              | - Fixed Allowance under NSO - DLRs.<br>- VOSL model for consumables.<br>- Geographic support OSI.<br>- Pulled.       |
| A                   | SHORECAL Consumer Level Retail (Consumables)                 | NWCF/1_ , 5_ , 9_  | - VOSL/ERM model.<br>- Pulled.<br>- Does not include FLRs 1 D/3 cog.   |
| V                   | NADEP/Depot Consumer Level Retail                            | NWCF/7_ APA/All APA  | - Fixed Allowance under NSO.<br>For NARF<br>SDLM and Engine support.<br>- Pulled.<br>- For Ships' Depot Level pools. |
| W                   | SHORCAL Consumer Level Retail and Ships' OSI (DLRs and FLRs) | End-Use/7_ , 0_ - NWCF/1_ (3_ ) , 5_ , (FLRs)<br>APA/All APA | - Fixed Allowance under NSO.<br>- Station Aircraft or Geographic support.<br>- Pickup support.<br>- Pulled.          |
| L                   | SHORCAL Consumer Level Retail (Pickup)                       | End-Use/7_ , 0_ - NWCF/1_ , 5_ , 9_ APA/All APA              | Fixed Allowance under NSO.<br>- Pickup for deployed requirement.   |

Table 1. Purpose Codes [Ref. 4].

The NAVICP manages DLRs held in a distribution system composed of Stock Points. Stock Points submit Transaction Reports (TRs) to NAVICP. These TRs determine what DLRs NAVICP is required to position at various stock points. The NAVICP stock management responsibilities include:

- Retain inventory control of DLRs through an extensive stock reporting system
- Provide technical assistance and cataloging services to the supply system and customers
- Compute aviation material requirements in both range and depth. This responsibility includes conducting and coordinating provisioning conferences and identification and transfer of items to be managed by other cognizant ICPs.
- Budget for and fund all assigned aviation material requirements
- Procure material directly from industry or other government agencies
- Allocate Naval Air System Command (NAVAIR) procured material to stock points, distribute material to fill replenishment stock requirements, and refer requisitions to stock points to meet requirements
- Dispose of material exceeding system requirements, including Support Equipment (SE) when authorized by NAVAIR
- Maintain aeronautical spares and spare parts catalogs. The catalog function includes obtaining National Stock Numbers (NSNs) from the Defense Logistics Service Center.
- Determine system asset rework requirements of DLRs to be processed by naval, inter-service or commercial rework facilities
- Develop, issue and update Allowance Requirements Registers (ARRs) and allowance and load lists applicable to the NAMP
- Provide primary material support for air-launched weapons

## **2. Navy Stock Points**

Navy Stock Points are called Fleet Industrial Supply Centers (FISCs), which act as the primary point of contact for material support of operational forces. Material is managed through the Uniform Automated Data Processing System (UADPS) where inventory is virtually consolidated. The FISC is also integrated with DLA and its ICPs. Stock Point management responsibilities include:

- Procure, receive, store and issue material
- Invoice customers for material issued

- Report issues of material to cognizant ICP
- Report receipt of material to cognizant ICP
- Invoice customers for DLRs issued

### **3. Aviation Support Division (ASD)**

Naval Air Stations with Aircraft Intermediate Maintenance Detachments (AIMDs) have Aviations Support Divisions (ASDs), which are generally co-located with the station AIMD. Together they manage and repair A, W and L purpose DLRs for all aircraft models assigned to the Air Station aviation squadrons. The ASD is responsible for maintaining a Ready For Issue (RFI) inventory for customers attached to the Air Station. ASD management responsibilities include:

- Report issues of A purpose DLRs to cognizant NAVICP
- Report receipt of A purpose DLRs to cognizant NAVICP
- Receive, store and issue W & L purpose DLRs
- Maintain fixed allowance levels of W & L purpose DLRs
- Ensure inventory is repaired and RFI DLRs are available for issue
- Report Non-RFI (NRFI) DLRs to NAVICP
- Report receipt of DLRs to NAVICP

### **B. NAVAL AVIATION MAINTENANCE PROGRAM (NAMP)**

These paragraphs are excerpts from OPNAVINST 4790.2H [Ref. 3]. The objective of the NAMP is to achieve and continually improve aviation material readiness and safety standards established by the Chief of Naval Operations (CNO), with coordination from the Commandant of the Marine Corps (CMC), for optimizing use of manpower, material, and funds. CNO's aviation material readiness standards include:

- Repair of aeronautical equipment and material at that level of maintenance that ensures optimum economic use of resources
- Protection of weapon systems from corrosive elements through the prosecution of an active corrosion control program
- Application of a systematic planned maintenance program and the collection, analysis, and use of data in order to effectively improve material condition and safety

The methodology for achieving the goals and intent of the NAMP objective is labeled “performance improvement.” Performance improvement must be targeted to accomplish the following broad goals:

- Increased readiness
- Improved quality
- Improved deployability
- Improved sustainability
- Reduced costs
- Enhanced preparedness for mobilization, deployability and contingency operations
- Enhanced supply availability
- Improved morale and retention
- Compliance with environmental laws, rules and regulations

### **1. Three Levels of Maintenance**

The NAMP is founded upon the three-level maintenance concept, Organizational (O-level), Intermediate (I-level) and Depot (D-level) performing rework and upkeep maintenance. It is the authority governing aviation maintenance management. It provides the management tools required for efficiently and economically using personnel and material resources in performing maintenance. It also provides the basis for establishing standard organizations, procedures and responsibilities for accomplishing all maintenance on naval aircraft, associated material and equipment.

Dividing maintenance into three levels allows management to:

- Classify maintenance functions by levels
- Assign responsibility for maintenance functions to a specific level
- Assign maintenance tasks consistent with the complexity, depth, scope and range of work to be performed
- Accomplish any particular maintenance tasks or support service at a level that ensures optimum economic use of resources
- Collect, analyze and use data to assist all levels of NAMP management

#### ***a. Organizational Level Maintenance***

To support aircraft operations, operating units perform organizational level maintenance on a day-to-day basis. The O-level maintenance mission is to maintain assigned aircraft and aeronautical equipment in a Full Mission Capable (FMC) status while continually improving the local maintenance processes. While O-level

maintenance may be done by I-level or D-level activities, the squadron maintenance personnel usually accomplish this type of maintenance.

O-level maintenance generally can be grouped under the categories of:

- Inspections
- Servicing
- Handling
- On-equipment corrective and preventive maintenance (including on-equipment repair and removing and replacing defective components known as Weapons Replacement Assemblies (WRAs) or Aviation Depot Level Repairables (AVDLRs))
- Incorporating Technical Directives into squadron equipment within prescribed limitations
- Record keeping and reports preparation
- Age Exploration (AE) of aircraft and equipment under Reliability Centered Maintenance (RCM)

***b. Intermediate Level Maintenance***

The I-level maintenance mission is to enhance and sustain the combat readiness and mission capability of supported activities by providing quality and timely material support at the nearest location with the lowest practical resource expenditure. Called AIMDs, they are generally co-located with ASDs to achieve efficient supply support.

I-level maintenance consists of on and off equipment material support and may be grouped as follows:

- Performing maintenance on aeronautical components known as (WRAs/SRAs or AVDLRs) and related SE
- Field Cognizant Activities (FCAs), which involve I-level performing calibration of designated equipment
- Processing aircraft components from stricken aircraft
- Providing technical assistance to supported units
- Incorporating Technical Directives
- Manufacturing selected aeronautical components, liquids and gases
- Performing on-aircraft maintenance when required.
- AE of aircraft and equipment under RCM

***c. Depot Level Maintenance***

D-level maintenance is performed at naval aviation industrial establishments to ensure continued flying integrity of airframes and flight systems during subsequent operational service periods. D-level maintenance is also performed on material requiring major overhaul or rebuilding of WRA/SRA subassemblies (both known as DLRs) and end items. It includes manufacturing, modifying, testing, inspecting, sampling and reclamation of parts. D-level maintenance supports I-level and O-level maintenance by providing engineering assistance and performing maintenance beyond their capabilities.

D-level maintenance functions may be generalized as follows:

- Standard D-level maintenance of aircraft
- Major special and structural inspections
- Reworking and repairing of engines, components and SE
- Corrosion repair and renewal of systems corrosion barrier
- Calibration by Navy calibration laboratories
- Incorporating Technical Directives
- Modifying aircraft, engines and SE
- Manufacturing or modifying parts or kits
- Technical and engineering assistance by field teams
- AE of aircraft and equipment under RCM

**2. Types of Maintenance**

The two types of maintenance performed within the naval establishment without distinction as to levels of maintenance are rework and upkeep. These two maintenance actions are performed on aeronautical equipment, and are defined in the NAMP [Ref. 3], as follows:

- Rework is performed only in the shore establishment. It may be performed on any program aircraft (operating or non-operating), aircraft equipment or aircraft SE. It is performed only by industrial type activities assigned the mission, task or functional responsibility of providing maintenance program support. Rework is performed with both military and civilian personnel and is managed by NAVAIR.
- Upkeep is performed only on operating aircraft, aircraft equipment or aircraft SE. It is performed by military type activities assigned aircraft or

equipment or assigned the mission, task or functional responsibility of providing direct support to such activities. Upkeep is normally performed with military personnel but can be performed by contractor personnel and is managed by major operating commands also known as the Aircraft Controlling Custodians (ACCs).

## **C. FIRST CONTRACT**

### **1. General**

These paragraphs are excerpts from the FIRST contract [Ref. 1]. FIRST creates a teaming arrangement between industry and the United States Government to improve parts availability and aircraft reliability for the F/A-18 E/F Super Hornet, with the overall goal of reducing Total Ownership Cost (TOC). The primary methods for accomplishing this will be continuous logistics processing with reliability and maintainability improvements. Boeing has management authority to meet system demand requirements, improve system/parts reliability and availability, and manage obsolescence. Boeing is to independently manage a total logistics support program for the F/A-18 E/F. Financial incentives are provided for innovation and efficiency to reduce the F/A-18 E/F total life cycle cost. This performance concept anticipates both logistics performance enhancements and cost of ownership benefits by leveraging proven commercial support concepts.

### **2. Contractor Responsibilities**

Boeing is to integrate a total support solution for F/A-18 E/F FIRST components. The total support solution includes meeting demand requirements from the Operational sites, Intermediate sites and Depot sites (NADEPs), as well as repairing and/or replacing all parts covered by this contract, including returned parts determined to be beyond economical repair. Boeing is to integrate all the support functions utilizing the following principles: 1) Supply Chain Management 2) Reliability Based Logistics/Trigger Based Asset Management 3) Government/Industry Teaming and 4) Integrated Information Systems.

The contract encompasses repairable and consumable material. Additionally, it requires Boeing to control configuration and obsolescence management. FIRST stipulates that Boeing is to become the Inventory Control Point (ICP) for the F/A-18 E/F. They are responsible for providing the material in support of aircraft spares and repair

demand, including initial outfitting and peculiar support equipment (SE) end item repair and attrition.

***a. Repairables***

Under the FIRST contract, repairable support is for F/A-18 E/F unique items (O, I and D Level), as listed in the contract Attachment (1). This includes unique WRAs, and SRAs that are components of these unique WRAs. Additionally, the contract includes the F/A-18 A-D demand of those unique SRAs, lower assemblies, and bit piece parts that support these items. [Ref. 5] F/A-18 E/F peculiar Support Equipment, as listed in Attachment (2), lower assemblies, and bit piece parts that support the peculiar Support Equipment are similarly included in this effort. [Ref. 6]

***b. Repair of Repairables***

Boeing is responsible for managing all depot level repair and overhaul support for applicable repairables. They are authorized to enter a teaming arrangement with the NADEPs in accordance with Title 10 U.S.C. section 2553.

As an Item Manager (IM), it's Boeing's decision whether to repair, overhaul, and/or modify any item (to the extent that a modification is required, Boeing's authority under FIRST is in accordance Class 1 Change Authority). They provide required repair parts to maintain sufficient repairable assets to meet fleet availability requirements for all equipment as identified in the FIRST Statement of Work (SOW). When components fail to operate correctly they are returned for repair or replacement, at no additional cost to the government.

***c. Requisition Processing***

As a designated Inventory Control Point (ICP), requisitions flow directly from the Defense Automated Addressing System (DAAS) to Boeing. If material is not available for shipment from existing inventory, Boeing provides an estimated date of delivery within two working days of receiving the requisition. FIRST requires Boeing to provide replies to any follow-ups and/or expedite requests within two working days. In the event material is not available from existing inventory, Boeing is still responsible for meeting contract requirements.

## **D. METRICS**

Metrics are used to determine levels of system and equipment performance. Here we will introduce aircraft readiness, supply support and contractor performance measurements.

### **1. Readiness**

Aviation squadrons measure equipment performance by Mission Capability (MC). There are two categories: 1) Full Mission Capable (FMC), and 2) Partial Mission Capable (PMC). Aircraft designated as FMC are fully functioning and combat capable; PMC aircraft are not fully functioning and have varying degrees of combat capability. These measurements determine the level of Operational Availability (Ao) at any given time. Higher FMC/MC rates indicate a higher state of readiness or Ao.

### **2. Supply Response Time (SRT)**

To define levels of expected supply support or customer satisfaction, one of the metrics used by the Navy is Logistic Response Time (LRT) and its equivalent Supply Response Time (SRT). This metric has several segments for material that may or may not be available at the local supply source, ASD Naval Air Station Lemoore in this thesis. We are will be using SRT as a baseline measurement for Direct Turn Over (DTO) material or repairables. The standards specified for SRT are based on Uniform Material Movement Inventory Processing Standards (UMMIPS) standards. UMMIPS standards establish normal processing time for DTO material requests for stocked and available components within the supply system and are used for measuring supply effectiveness. [Ref. 2]

### **3. FIRST Material Processing Goals**

The FIRST award fee plan delineates three areas of logistical support: 1) Material, 2) Information Systems Connectivity, and 3) Fleet Support. Material logistics is further evaluated with regards to Supply Response Time, Time on Backorder and Aircraft Carrier (CV) effectiveness. Boeing, acting as an ICP under FIRST, is tasked to operate within guidelines established for NAVICP stocked and non-stocked materials. This thesis researches Boeing's SRT and their ability to meet material delivery expectations for FIRST coded repairable components. [Ref. 1]

## **E. REQUISITION OF REPAIRABLES**

Customer requisitioned repairable components involve a detailed process, which directly or indirectly spans all three levels of maintenance and the entire Navy supply system. This process has varying degrees of transparency to the customer depending on the supply system's inventory posture and responsiveness to component demands and/or changes in component reliability.

When maintainers determine what repairable component is needed, there are two processes for providing them with Ready-For-Issue (RFI) components. In the first scenario, ASD issues an RFI component from W purpose stock. The stock is then replenished by either repairing the retrograde at the I-level or by submitting a stock requisition to NAVICP to obtain a replacement. The second scenario is when ASD does not have an RFI W purpose stock component available. The AIMD must either repair the squadron retrograde as an Expeditious Repair (EXREP), or an A purpose stock is requisitioned as a Direct Turnover (DTO) document from NAVICP.

All repairables are requisitioned on a one-for-one basis. To receive an RFI repairable component, a NRFI retrograde must be turned into the supply system. Before a repairable is requested from the system, the maintainer will troubleshoot and identify the faulty component on the aircraft. Once the component is removed, it must be turned into supply and a replacement requested.

The entire supply process is transparent to the maintainers unless the repairable part is locally unavailable. The degree of transparency depends solely upon the system's ability to deliver parts when they are needed.

## **F. CHAPTER SUMMARY**

This chapter introduced the processes and measures of effectiveness by which Navy (organic) and Boeing FIRST (contractor) supply provides support to the operational fleet. Additionally, we introduced the NAMP and the levels of maintenance in which the concepts of fleet support are derived. By carefully explaining these processes, we have set the basis for our study. The following chapter will introduce the methodology that

will be used to map out and measure the effectiveness of Navy (organic) support against the Boeing FIRST (contractor) support.

### **III. METHODOLOGY**

#### **A. INTRODUCTION**

This chapter summarizes the methodology that will be used in describing the Navy (organic) and FIRST (contractor) requisition processes. Additionally, it will describe the methodology that will be utilized for comparing associated SRTs for each process. Initially the chapter restates the research question and defines the research objectives. The metric tools are then described and the theoretical relationship between SRT and Operational Availability (Ao) is established.

##### **1. Research Objectives**

This research analyzes the organic and FIRST requisition process used at Naval Air Station Lemoore, CA. The primary purpose of this research is to compare the FIRST contract ordering process with the standard Navy ordering process for squadrons requisitioning repairable components, and to determine if the FIRST program provides improved Operational Availability for F/A-18 E/F aircraft.

##### **2. Measurement Questions**

- What is the document and component process flow when a squadron orders a component through the standard Navy requisition system?
- What is the document and component process flow when a squadron orders a component through FIRST contract requisition system?
- What are the benefits/drawbacks of the FIRST requisition processes versus the standard Navy requisition process?
- What are the FIRST contract metrics for delivering repairable components?
- Is there a positive or negative impact on overall mission capability rates under the FIRST process?

#### **B. METRIC ANALYSIS TOOLS**

Defining the process and flow of documents and repairables will be accomplished by flowcharting. This develops a clear map of the repairables ordering process. This will be used to identify differences in each process and the proximity of Supply Response Time in relationship to the customers/end-users.

Supply Response Time is a key NAVSUP measurement tool. It captures the transactions that are processed through the wholesale system and measures the time that the supply system takes to satisfy a customer's order or requisition. Metrics used to measure SRT for all Navy customers are defined by NAVSUP and applied in the FIRST contract for determining award fee levels. The SRT measurement explains the impact of inventory on readiness.

### **1. Mapping the Process**

Diagrams will be based on the flow of material and documents requested from the user through the supply system. They will highlight key flow points and the decisions made to deliver repairables material and document movement to their ultimate destination. These flowcharts will visually relate the requirements of the NAMP as accomplished by NAVAIR, NAVSUP and Boeing.

Data used to develop the flowcharts will come from publications and instructions promulgated by the Navy and Boeing. Interviews will be conducted to determine the nuances of the ordering process, to include material and document linking, movement and administration. These interviews will be conducted with Navy and Boeing personnel who will then review and verify the flowcharts to ensure an accurate map of the organic and FIRST ordering process

### **2. Supply Response Times**

Supply Responses Time as defined by NAVSUP is the total elapsed time between issuance of a customer order and satisfaction of that order. Supply Response Time metrics describe the length of time it takes for a customer to receive material after the requirement is initiated.

- SRT is a beginning to end measurement, initiated when a customer transmits a request document for material (repairable) and finished when the customer acknowledges receipt of requested material (repairable)
- SRT can break down and measure individual and successive segments of the supply chain process
- SRT is measured and displayed in days based on Force Activity Designator (FAD), Project Code and Required Delivery Date (RDD)

SRT is calculated by subtracting the request date from the receipt date on each document to measure elapsed time. SRT considers all transactions and delivery

segments, including retail, I-level maintenance actions, wholesale, procurement, and D-level repair. SRT sets the customer's expectations for the system and measures if the system is performing to those expectations.

**a. *Priority Designation***

The metrics for determining SRT utilize Force Activity Designators, Urgency of Need Designators (UNDs), Priority Designators (PDs), Required Delivery Dates (RDD's) and Project Codes. Supply procedures ashore [Ref. 2] state standards and metrics for DTO material delivery times (not available at the local supply source, ASD NASL in this thesis). Urgency of Need Designators (UND) are used in conjunction with Force Activity Designators (FADs), to determine Priority Designators (PDs). Table 2 relates UNDs and FAD to Priority Designators. All F/A-18 squadrons fall within FAD I, II or III; all DTO DLRs fall within UND A or B.

| Urgency of Need Designator |                      | FAD                 |    |     |    |    |
|----------------------------|----------------------|---------------------|----|-----|----|----|
|                            |                      | I                   | II | III | IV | v  |
|                            |                      | Priority Designator |    |     |    |    |
| A                          | Unable to Perform    | 01                  | 02 | 03  | 07 | 08 |
| B                          | Performance Impaired | 04                  | 05 | 06  | 09 | 10 |
| C                          | Routine              | 11                  | 12 | 13  | 14 | 15 |

Table 2. FAD and UND to Priority Designators Matrix [Ref. 2:p. 3-55].

**b. *UMMIPS Goals (DTO Material)***

UMMIPS standards (Table 3) establish normal processing time for material requests from material stocked and available for issue in supply systems, and are used too measure the effectiveness of actual performance. If PDs indicated in the table do not meet delivery requirements, Required Delivery Dates (RDDs) are assigned by squadron personnel [Ref. 2].

| UMMIPS TIME STANDARD IN CALENDAR DAYS <sup>1</sup>               |                        |    |    |    |    |   |    |    |    |    |                      |    |    |    |                 |
|--|------------------------|----|----|----|----|---|----|----|----|----|----------------------|----|----|----|-----------------|
| Priority Designator and Required Delivery Date <sup>2</sup>      | PD 01 - 08             |    |    |    |    | PD 01 - 08, RDD of 777 or PD 01 - 15, RDD of 444 or 555 |    |    |    |    | PD 01 - 15 Blank RDD |    |    |    |                 |
| Pipeline Time Segment  | RDD of 999, N__ or E__ |    |    |    |    |   |    |    |    |    |                      |    |    |    |                 |
| A. Requisition Submission  | 1                      |    |    |    |    | 1   |    |    |    |    | 2                    |    |    |    |                 |
| B. Passing Action  | .5                     |    |    |    |    | 1   |    |    |    |    | 1                    |    |    |    |                 |
| C. ICP Availability <sup>3</sup> Determination                   | 1                      |    |    |    |    | 1   |    |    |    |    | 1                    |    |    |    |                 |
| D. Depot Storage Site <sup>4</sup> and/or Processing and Packing | 1                      |    |    |    |    | 1   |    |    |    |    | 5                    |    |    |    |                 |
| E. Transportation Hold and CONUS Intransit                       | 1                      |    |    |    |    | 4   |    |    |    |    | 10 <sup>5</sup>      |    |    |    |                 |
| Area <sup>6</sup>  | CONUS:                 | 1  | 2  | 3  | 4  | CONUS:  | 1  | 2  | 3  | 4  | CONUS:               | 1  | 2  | 3  | 4               |
| F. POE and/or CCP Processing and intransit to carrier            | N/A                    | 1  | 1  | 1  | 3  | N/A   | 1  | 1  | 1  | 3  | N/A                  | 10 | 10 | 10 | 21 <sup>2</sup> |
| G. Intransit Overseas  | N/A                    | 1  | 1  | 2  | 3  | N/A   | 1  | 1  | 2  | 3  | N/A                  | 10 | 15 | 25 | 30              |
| H. POD Processing  | N/A                    | 1  | 1  | 1  | 1  | N/A   | 1  | 1  | 1  | 2  | N/A                  | 3  | 3  | 3  | 5               |
| I. Intra-theater Intransit                                       | N/A                    | 1  | 1  | 1  | 1  | N/A   | 1  | 1  | 1  | 1  | N/A                  | 5  | 5  | 5  | 5               |
| J. Receipt take-up by Requisitioner                              | .5                     | .5 | .5 | .5 | .5 | 1   | 1  | 1  | 1  | 1  | 3                    | 3  | 3  | 3  | 3               |
| K. Total Order Ship Time   | 5                      | 9  | 9  | 10 | 13 | 9   | 13 | 13 | 14 | 18 | 22                   | 50 | 55 | 65 | 83              |

Table 3. UMMIPS Time Standard in Calendar Days [Ref. 2:p. 3-56].

**c. NAMP Goals For ASD**

The NAMP [Ref. 3] establishes normal processing time for all squadron material requests. Table 4 presents the material processing time standards used for measuring the effectiveness of an ASDs actual performance. Issue Priority Designator Group is equivalent to UND used in the UMMIPS Table 3. ASDs are to deliver material or provide accurate document status within the prescribed time frames.

| Issue Priority Group | Priority Designator | Processing Time |
|----------------------|---------------------|-----------------|
| 1                    | 1 – 3               | 1 Hour          |
| 2                    | 4 – 8               | 2 Hours         |
| 3                    | 9 – 15              | 24 Hours        |

Table 4. NAMP Material Processing Time Standards [Ref. 3].

**3. FIRST Supply Response Time Incentives**

The award fee plan delineates three areas of logistical support: Material, Information Systems Connectivity and Fleet Support. Material logistics is further

evaluated with regards to Supply Response Time (SRT), Time on Backorder and CV effectiveness. Boeing, acting as an ICP under FIRST, operates within guidelines established for NAVICP stocked and non-stocked materials. This thesis researches Boeing's SRT; and their ability to meet material delivery expectations in response to requisitions for repairables that a USN activity is authorized to stock (PA source code). Boeing is provided with required Supply Response Times for repairables and consumable items, Technical Performance Measures (TPM) and incentives standards for compliance.

**a. Supply Response Times**

Table 5 provides Priority Designator and Required Delivery Dates Matrix for material requested from Boeing through FIRST. These are the same as UMMIPS goals prescribed for organic support.

| Project Codes           |   |  |                         |                         |   |  |  |
|-------------------------|---|--|-------------------------|-------------------------|---|--|--|
| Priority Indicator (PD) | 023, 705, 706, 707, 730, 756, 757, 780, 9BU, 9PV, 9GF, 9*, AH0, AK5, AK7, BK0, SK2, Z3Y, Z36, ZC8, ZCN, ZF7, ZK3, ZQ3, ZQ9, OTHER | AB0, AE1, AE3, AE6, AE8, AK1, AK2, AN1, BK1, Z49 | 77E, AP5, EE1, EE2, BP5 | EB0, EE4, EE5, EE8, EE9 | 77A, 77B, 77C, 77D, 770, 774, 775, A05, CBR, OP5, TY4, TY5, YY9 |  |  |
| 1                       | 48 HRS  | 120 HRS  | 120 HRS                 | 120 HRS*                | 360 HRS   |  |  |
| 2                       |   |  |                         |                         |   |  |  |
| 3                       | 120 HRS   |  | 120 HRS                 | 360 HRS                 |   |  |  |
| 4                       |   |  |                         |                         |   |  |  |
| 5                       | 360 HRS   |  | 360 HRS                 | 360 HRS                 |   |  |  |
| 6                       |   |  |                         |                         |   |  |  |
| 7                       | 360 HRS   |  | 360 HRS                 | 360 HRS                 |   |  |  |
| 8                       |   |  |                         |                         |   |  |  |
| 9                       | 360 HRS   |  | 360 HRS                 | 360 HRS                 |   |  |  |
| 10                      |   |  |                         |                         |   |  |  |
| 11                      | 360 HRS   |  | 360 HRS                 | 360 HRS                 |   |  |  |
| 12                      |   |  |                         |                         |   |  |  |
| 13                      | 360 HRS   |  | 360 HRS                 | 360 HRS                 |   |  |  |
| 14                      |   |  |                         |                         |   |  |  |
| 15                      | 360 HRS   |  | 360 HRS                 | 360 HRS                 |   |  |  |
| 16                      |   |  |                         |                         |   |  |  |

Table 5. Priority Designator and Required Delivery Dates Matrix [Ref. 7].

**b. Technical Performance Measures**

FIRST has four Technical Performance Measures: Standard of Excellence, Expected, Threshold and Bound. These measure Boeing's ability to fill Naval requirements for stocked repairable and consumable material transmitted to them in accordance with the Priority Designator RDD matrix (Table 5) and TPM Completion Metrics (Table 6).

|                               | FY 2001         | FY 2002         |
|-------------------------------|-----------------|-----------------|
| <b>Standard of Excellence</b> | <b>85%</b>      | <b>90%</b>      |
| <b>Expected</b>               | <b>80%</b>      | <b>85%</b>      |
| <b>Threshold</b>              | <b>70%</b>      | <b>75%</b>      |
| <b>Bound</b>                  | <b>&lt; 70%</b> | <b>&lt; 75%</b> |

Table 6. TPM Completion Metrics [Ref. 7].

*c. Award Fee Incentives*

Supply response award fees are based on the total percentage of requisitions completed within prescribed Supply Response Times (Table 7), which provide incentives beyond Technical Performance Measures. Award fee incentives provide Boeing payment based on the percent of compliance and are ultimately designed to improve performance.

| Supply Response Time – Repairables & Consumables |              |                  |
|--|--------------|------------------|
| Contractor Performance                           |              | Award Fee Amount |
| <b>Standard of Excellence</b>                    | <b>90%</b>   | <b>100%</b>      |
|  | 89%          | 96%              |
|  | 88%          | 92%              |
|  | 87%          | 88%              |
|  | 86%          | 84%              |
| <b>Expected</b>                                  | <b>85%</b>   | <b>80%</b>       |
|  | 84%          | 78%              |
|  | 83%          | 76%              |
|  | 82%          | 74%              |
|  | 81%          | 72%              |
|  | 80%          | 70%              |
|  | 79%          | 68%              |
|  | 78%          | 66%              |
|  | 77%          | 64%              |
|  | 76%          | 62%              |
| <b>Threshold</b>                                 | <b>75%</b>   | <b>60%</b>       |
| <b>Bound</b>                                     | <b>0-74%</b> | <b>0%</b>        |

Table 7. FY 2002 and 2003 Award Fee Conversion Chart [Ref. 7].

**4. Readiness Relationship to Supply Response Time**

*a. Squadron Readiness Measures*

One of the factors that affect squadron FMC/PMC (MC) rates is supply delivery times or SRT. In order to measure the difference between Navy (organic)

supply and FIRST (contractor) supply, we will present the data sets for two squadrons operating solely under organic support and two squadrons operating under the new combined method. This comparison will suggest some general readiness assumptions using these findings.

***b. Supply Response Time Affects on Readiness***

At organizational level maintenance activities, the relationship between SRT and Operational Availability is linked through high priority repairable requisitions. Readiness is directly affected by the time it takes to perform maintenance. Furthermore, the time to complete maintenance largely depends on supply response time. The inherent relationship of Ao to SRT is expressed in the following formulae:

$$(1) \quad A_o = \frac{\text{Up Time}}{\text{Total Time}}$$

**Where Up Time = Mission Capable**

$$(2) \quad A_o = \frac{\text{Up Time}}{\text{Up Time} + \text{Down Time}}$$

$$(3) \quad A_o = \frac{\text{Mean Time Between Maintenance}}{\text{Mean Time Between Maintenance} + \text{Mean Time To Repair}}$$

$$(4) \quad A_o = \frac{\text{MTBM}}{\text{MTBM} + \text{MTTR}}$$

**Where MTTR = MMDT+ MADT + MLDT**

**Where MLDT= MSRT**

$$(5) \quad A_o = \frac{\text{MTBM}}{\text{MTBM} + \text{MMDT} + \text{MADT} + \text{MSRT}}$$

**Where**

**MTBM = Mean Time Between Maintenance**

**MTTR = Mean Time To Repair**

**MMDT= Mean Maintenance Delay Time**

**MADT = Mean Administrative Delay Time**

**MLDT = Mean Logistics Delay Time**

**MSRT = Mean Supply Response Time**

## **5. Application of Metrics**

The metrics described above will be used to answer the two primary thesis questions. We will examine the flowcharts and compare for commonalties and differences. The flowcharts will be analyzed for anomalies seeking to identify advantages or disadvantages. Each flowchart will be explained to identify where SRT is applied to each process

We will use the SRT metric to measure wholesale repairables requisition data obtained from NASL ASD for supported F/A-18 squadrons. Our efforts will concentrate on documents that are not initially satisfied through the retail or I-level. Thus, we will capture the DTO repairables requiring an ICP supply response. We will then compute MSRT in hours using actual squadron requisition data during the same period. Additionally, we will use actual squadron 3M data to benchmark squadron MC. The results of each process MSRT will be used to measure its affect on Operational Availability (Ao).

## **C. SUMMARY**

In this chapter, we have described the methodology for answering our primary and secondary research questions. We have described how each process will be mapped out and explained in detail. Additionally, we have explained how we intend to compare the two programs through squadron MC rates. By actually computing real supply data, we will be able to present actual SRT rates for each program. Using the computed SRT rates for each program, we will then estimate each program's affect on Operational Availability (Ao).

### A. MAPPING THE PROCESS

## 1. Organic Process: RFI Component Available

[illegible]

25

***a. Issue Process***

- Squadron orders a component in the Naval Aviation Logistic Command Information System (NALCOMIS)
- ASD receives and processes the document through NALCOMIS then issues the RFI component to the squadron
- Material Delivery Unit (MDU) delivers the RFI component to the squadron and retrieves the NRFI retrograde
- Squadron completes the requisition and installs the RFI component in aircraft

***b. Component Repair Process***

- If AIMD has the repair capability, the retrograde is inducted into the repair cycle Figure 1
- If the component can be repaired, it is returned to ASD and stocked as an RFI component
- If AIMD does not have repair capability or the retrograde cannot be repaired, it moves into the replenishment process

***c. Component Replenishment Process***

At this point, the document and retrograde take separate paths.

- Retrograde is processed as Beyond Capability of Maintenance (BCM) and shipped to the Advanced Trace-ability and Control (ATAC) hub
- ATAC receives the retrograde and liaises with NAVICP to determine if repair can be done at Depot, OEM or scrapped directly. NAVICP monitors repair schedules and scrap rates while making necessary purchases to maintain RFI component inventory levels.
- NAVICP directly ships RFI components to either a Stock Point or an ASD  
The path of the document is intended to efficiently locate RFI components and ship them to ASD.
- The stock document is electronically passed to NAVICP
- NAVICP determines if the component is available, first at the Stock Point, then Depot or OEM repair facilities. If no components are available, a purchase is executed.

Once an RFI component is acquired, it's matched with the document and shipped to ASD and placed back in stock.

## **2. Organic Process – RFI Component Not Available**

Starting at squadron O-level maintenance. This section describes the order, EXREP and DTO process in the Figure 1 flowchart.

### ***a. Order Process***

- Squadron orders a component in NALCOMIS
- ASD receives and processes the document through NALCOMIS for pickup at squadron
- MDU retrieves the NRFI retrograde

### ***b. EXREP Process***

- If AIMD has repair capability, the NRFI retrograde is inducted into the repair cycle as an EXREP
- If the component is repaired, it is returned to ASD and MDU delivers it to squadron
- Squadron completes the requisition and installs the component in aircraft
- If AIMD does not have repair capability or if the retrograde cannot be repaired, it becomes a DTO process

### ***c. DTO Process***

At this point, document and retrograde once again take separate paths.

- The NRFI retrograde is processed as BCM and shipped to the Advanced Trace-ability and Control (ATAC) hub
- ATAC receives the retrograde and liaises with NAVICP to determine if repair is done at Depot, OEM or scrapped directly. NAVICP monitors repair schedules and scrap rates, making purchases as necessary to maintain RFI component inventory levels.
- NAVICP directly ships the RFI component to either a Stock Point or ASD. The DTO document is passed expeditiously and all efforts are made to locate RFI components and ship them to ASD.
- DTO document is electronically passed to NAVICP
- NAVICP determines if the component is available at a Stock Point, then Depot or OEM repair facilities. If not available, an emergency purchase is executed.
- At this juncture, the DTO document is matched with a component and shipped to ASD where MDU delivers it to squadron.
- Squadron completes the requisition and installs the component in aircraft.

### 3. FIRST – RFI Component Available

FIRST components ordered by a squadron, follow the same issue and repair processes as the organic requisition process. The only difference emerges during ASD component replenishment. The flowchart in Figure 2 reflects the addition of Boeing as the ICP.

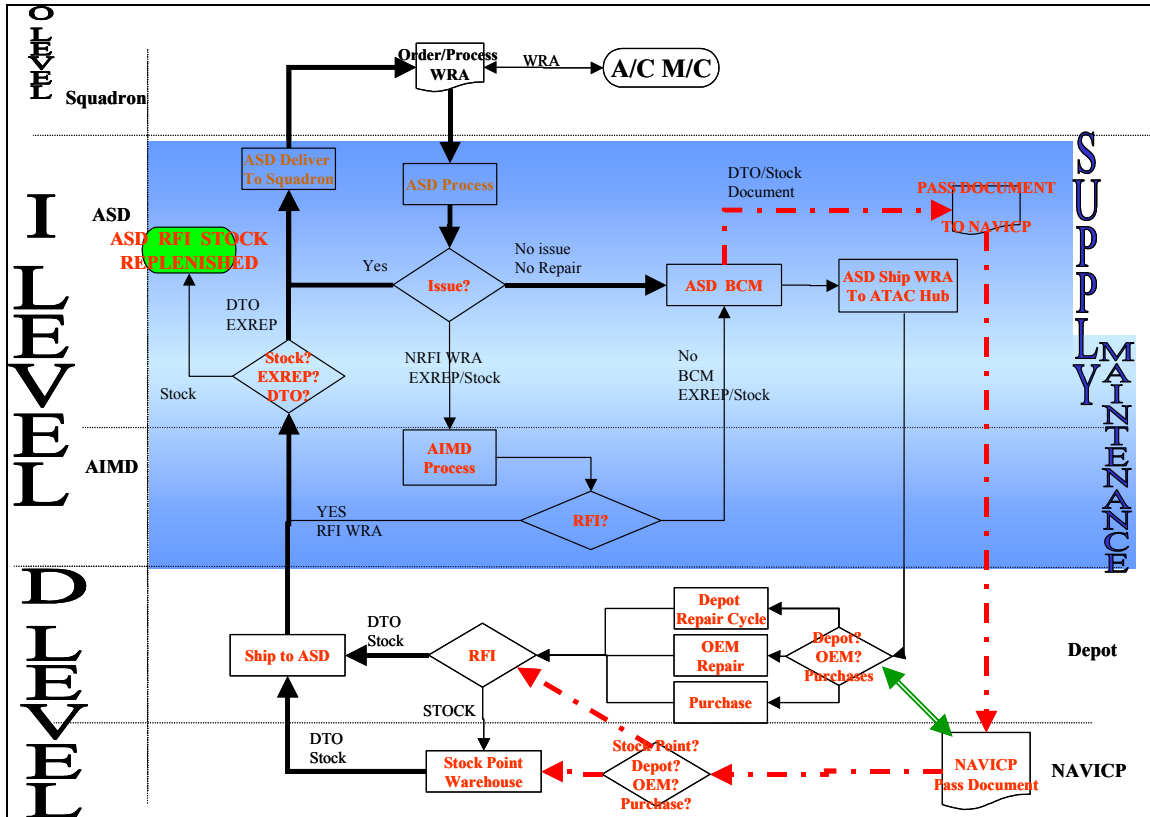


Figure 2. FIRST Requisition Process.

#### a. FIRST Component Replenishment Process

When a component is BCM'd the document and retrograde take separate paths.

- Retrograde is processed as a BCM and shipped to Boeing
- Boeing receives retrograde and determines if repair is done by USN Depot, Boeing manufacturing, OEM or scrapped directly. Boeing monitors repair schedules and scrap rates, making purchases or manufacturing as necessary to maintain RFI component inventory levels.
- Boeing directly ships RFI components to either a FIRST warehouse or ASD

The path of the document is intended to efficiently locate RFI components and ship them to ASD.

- The stock document is electronically passed to NAVICP
- NAVICP electronically passes document to Boeing
- Boeing determines if component is available, first at their warehouse, then the USN Depot, then Boeing manufacturing or OEM repair facilities. If not available in time, a new component is manufactured or purchased from the OEM.
- The document is matched with the component and shipped to ASD and stocked as an RFI component

#### **4. FIRST - Component Not Available**

As in the previous case, FIRST components follow identical paths for ordering and completing EXREP requirements. Again using the flowchart in Figure 2 the DTO process now includes Boeing.

##### ***a. FIRST DTO Process***

When the component is BCM'd the document and retrograde once again take separate paths.

- Retrograde is processed as BCM and shipped to Boeing
- Boeing receives retrograde, then determines if repair is done by USN Depot, Boeing manufacturing, OEM or scrapped directly. Boeing monitors repair schedules and scrap rates, making purchases or manufacturing as necessary to maintain RFI component inventory levels.
- Boeing directly ships RFI components to either a FIRST warehouse or ASD

The DTO document is passed expeditiously and all efforts are made to locate RFI components and ship them to ASD.

- DTO document is electronically passed to NAVICP
- NAVICP electronically passes document to Boeing
- Boeing determines if the component is available, first at their warehouse then the USN Depot, then Boeing manufacturing or OEM repair facilities. If not available, a new component is manufactured or purchased from the OEM.
- At this juncture, the DTO document is matched with the component and shipped to ASD where MDU delivers it to the squadron
- Squadron completes the requisition and installs the component in aircraft

## **5. Process Summary**

The flowcharts illustrate that differences in the two processes are transparent at the customer level. Establishing Boeing as an ICP is effectively a lateral transfer of repairables management and inventory. The concept is a mirror image of the existing process for repairables management throughout the Navy.

While service inventories are virtually connected allowing direct routing of documents to inventory warehouses, Boeing's inventory is not. This requires the additional step of NAVICP processing, and then referring the documents to Boeing. The extra step in the process is accomplished electronically, however still adds additional SRT to the process as a whole. The additional layer also reduces the Total Asset Visibility (TAV) at the wholesale level. The status of repair scheduling and purchases are not available to the customer in conjunction with the repairables managed by NAVICP.

Currently, removing NAVICP from the FIRST process would make the two processes nearly identical. At this point, for all practical purposes, Boeing is being paid to perform the identical functions of the NAVY.

## **B. DATA ANALYSIS**

### **1. Data Collection for Ao**

The mission capability rates used for this analysis were obtained through the assistance of the Commander Strike Fighter Wing Pacific. They include all 3M Summary data for VFA-125, VFA-122, VFA-115 and VFA-25 for the period of 01 April 2002 through 30 June 2002. The Operational Availability (Ao) rate for each squadron is summarized in Table 8. The combined Type Model Series (TMS) rate was calculated using a weighted average based upon the total aircraft assigned to each squadron during each month. As a point of reference, the Chief of Naval Operations readiness goal for mission capability is 75%.

| Squadron | Type Aircraft  | Support Type  | April | May   | June  | Combined three month total for each TMS |
|----------|----------------|---------------|-------|-------|-------|---|
| VFA-125  | F/A-18 A/B/C/D | Navy Organic  | 48.2% | 58.6% | 66.9% |   |
| VFA-25   | F/A-18 C/D     | Navy Organic  | 64.3% | 56.1% | 49.5% | <b>57.4%</b>                            |
| VFA-122  | F/A-18 E/F     | FIRST/Organic | 69.2% | 67.3% | 64.6% |   |
| VFA-115  | F/A-18 E/F     | FIRST/Organic | 66.6% | 65.2% | 62.7% | <b>66.8%</b>                            |

Table 8. Mission Capability Rates (Ao) by Squadron and Type Model Series (TMS).

## 2. Data Collection for SRT

The requisition data used for this analysis was obtained from NAS Lemoore with assistance of the ASD Officer. It was collected from archived NALCOMIS maintenance and inventory data retrieved for the time frame of 01 April 2002 through 30 June 2002. The data includes two deploying squadrons and two training squadrons. The selection of VFA-125, VFA-122, VFA-25 and VFA-115 allowed the researchers the opportunity to include the SRT of both training and operational commands working under each system. VFA-125 and VFA-25 are F/A-18 A/B/C/D squadrons working under the organic Navy support system. VFA-122 and VFA-115 are F/A-18 E/F squadrons utilizing the new combined FIRST/organic support system.

The data population included IPG I-III and various types of COG and SM&R coded material. Analysis was done exclusively on IPG I requisitions, for priority 2 and 3 repairable parts with a COG of 7R, 1R, and OR with an SM&R (Source of Maintenance Requirement) code of PAO (Planned Requirement to Stock, Installed at O-level). These are documents that represent high priority aviation material requirements that directly impact the MC of aircraft. Additionally, they are required to be stocked at the wholesale level (ICP).

To compare SRT between NAVICP and Boeing, the data concentrated on the wholesale DTO segment. Wholesale data represents material not available at the retail level (ASD Lemoore) and consists of only those requisitions for material managed by an ICP. Because of their impact on readiness, these documents are individually tracked and expedited daily. To get an accurate measurement of SRT, Table 9 illustrates how each data set was cleaned up.

| Data Origin |            |        |         | Removed              |            |            |                     |                  | Number of Documents |
|-------------|------------|--------|---------|----------------------|------------|------------|---------------------|------------------|---------------------|
| Squadron    | Period     | ICP    | Records | Duplicate & Canceled | Other Cogs | Other SM&R | Priority 5-6 & 2-13 | NAVICP or Boeing |                     |
| VFA-122     | APR-JUN 02 | Boeing | 410     | 129                  | 163        | 23         | 29                  | 39               | 27                  |
| VFA-125     | APR-JUN 02 | NAVICP | 218     | 91                   | 12         | 34         | 4                   | 0                | 77                  |
| VFA-115     | APR-JUN 02 | Boeing | 227     | 124                  | 30         | 2          | 49                  | 14               | 8                   |
| VFA-25      | APR-JUN 02 | NAVICP | 84      | 43                   | 22         | 0          | 3                   | 0                | 16                  |

Table 9. Data Clean-Up.

The SRT (measured in hours) was computed using an Excel spread sheet for each squadron. This was accomplished by subtracting the date and time the requisition was referred to an ICP (REFER status) from the date it was completed by the receiving squadron (COMPL status). Mean supply response time was then computed for each squadron. Because of the smaller data sets, VFA-115 and VFA-122 data were combined to summarize Boeing's MSRT and VFA-125 and VFA-25 data were combined to summarize NAVICP's MSRT. To compare the two MSRTs, a two-sample t-test for difference in mean was used to test for significance. To compare ICP performance to UMMIPS, contract requirements and award fee incentives, a spread of SRT data was measured and percentiles assigned. Additionally, a z-test for difference in sample proportions was used to test for significance.

### 3. Comparison of Supply Response Time

Table 10 represents the summary data for all squadrons. The MSRT was 313.88 hrs for VFA-122/115 and 597.65 hrs for VFA-125/25. A two-sample test for means confirmed the difference between the two systems mean SRT rates (283.768 hrs) is significant. Boeing takes less time to deliver components.

| Squadron    | ICP    | Number of Documents | MSRT (in hrs) | Standard Deviation |
|-------------|--------|---------------------|---------------|--------------------|
| VFA-122/115 | Boeing | 35                  | 313.88        | 499.20             |
| VFA-125/25  | NAVICP | 93                  | 597.65        | 603.86             |

Table 10. Summary Statistics for Squadron MSRT.

Table 11 compares of the squadrons at the 25<sup>th</sup>, 29<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 85<sup>th</sup> percentiles and confirms what is evident from the means testing. NAVICP SRTs are significantly

longer than Boeing's. However, a test comparing NAVICP and Boeing's proportion of successful 48hour deliveries for difference is insignificant. Boeing achieves the issue group one SRT threshold of 48 hours only 29 percent of the time, well below the contract requirement of 75 percent and expected performance of 85 percent. It is also noted that NAVICP only achieved a 48 hour delivery three times.

| Percentiles | VFA-122/115<br>Number | VFA-122/115<br>(SRT in hrs) | VFA-125/25<br>Number | VFA-125/25<br>(SRT in hrs) |
|-------------|-----------------------|-----------------------------|----------------------|----------------------------|
| 85          | 30                    | 1104.23                     | 79                   | 1223.45                    |
| 75          | 26                    | 200.33                      | 70                   | 845.70                     |
| 50          | 17                    | 97.78                       | 46                   | 362.16                     |
| 29          | 10                    | 31.54                       | 27                   | 155.29                     |
| 25          | 8                     | 29.56                       | 23                   | 144.31                     |

Table 11. Data Percentiles for Squadrons.

#### 4. Affects on Readiness

Previously, we stated that SRT affects mission capability rates. Thus far we have established actual mission capability rates for each TMS and determined the actual MSRT for each program. We can now use the formula established in Chapter III to estimate each program's effect on overall readiness. Recall formula 5:

$$A_o = \frac{\text{MTBM}}{\text{MTBM} + \text{MMDT} + \text{MADT} + \text{MSRT}}$$

Utilizing an Excel spreadsheet, we used the known MTBM and MSRT to determine the unknowns of the combined MMDT and MADT. These were derived for each system by subtracting known MTBM and MSRT from the total time for each type aircraft as summarized in Table 12.

| Squadron    | ICP    | Total Time<br>(in hrs) | MTBM<br>(uptime)<br>(in hrs) | MSRT   | MMDT<br>&<br>MADT<br>(in hrs) |
|-------------|--------|------------------------|------------------------------|--------|-------------------------------|
| VFA-122/115 | Boeing | 2184                   | 1459.25                      | 313.88 | 410.87                        |
| VFA-125/25  | NAVICP | 2184                   | 1253.73                      | 597.65 | 313.88                        |

Table 12. Break Down of Total Time.

Utilizing the above formula we calculated overall mission capability rates of both programs as follows:

$$A_{oNAVICP} = \frac{1253.73}{1253.73 + 332.62 + 597.65} = 57.41\%$$

$$A_{oBoeing\ First} = \frac{1459.25}{1459.25 + 410.87 + 313.88} = 66.82\%$$

Utilizing the above formula we estimated the affect of both programs on overall mission capability rates. We inputted the FIRST program MSRT into the F/A-18 A/B/C/D NAVICP equation to estimate the change it would have on the F/A-18 A/B/C/D Ao. The net result of doing so increased F/A-18 A/B/C/D readiness by 8.57 percent, a 14.9 percent increase over the current level.

$$A_{oNAVICP} = \frac{1253.73}{1253.73 + 332.62 + 313.88} = 65.98\%$$

Conversely, we inputted the NAVICP MSRT into the Boeing equation to estimate the change it would have on the F/A-18 E/F Ao. The net result of doing so decreased F/A-18 E/F Ao by 7.69 percent, an 11.5 percent decrease over the current level

$$A_{oBoeing\ First} = \frac{1459.25}{1459.25 + 410.87 + 597.65} = 59.13\%$$

Table 13 summarizes the results. It is clear that a significant difference in MSRT of 283.7 hours results in a 7.68 percent MC increase for NAVICP and 8.57 percent MC decrease for Boeing FIRST.

| Squadron    | ICP    | MSRT<br>(in hrs) | Difference<br>(in hrs) | MC %<br>Combined | MC %<br>Estimated | %<br>Difference |
|-------------|--------|------------------|------------------------|------------------|-------------------|-----------------|
| VFA-122/115 | Boeing | 313.88           | 283.7                  | 66.82            | 59.13             | (8.57)          |
| VFA-125/25  | NAVICP | 597.65           | (283.7)                | 57.41            | 65.98             | 7.68            |

Table 13. Difference Summary.

## **5. Affects of F/A-18 A/B/C/D Age on the SRT Model**

We have now compared the SRT's of the Navy organic process against that of the FIRST process. The FIRST process clearly delivers DTO repairable parts for the F/A-18 E/F faster than the Navy organic process does for the F/A-18 A/B/C/D aircraft. A possible explanation for this difference is the age and lower reliability of the F/A-18 A/B/C/D aircraft. According to Table 9, the older aircraft required 93 DTO repairable parts while the newer aircraft only required 35 during the same timeframe. Since the amount of aircraft represented in each process was essentially the same, the older aircraft are obviously placing more demand onto the repair and replenishment system. The essential difference may lie between the availability of F/A-18 E/F parts and F/A-18 A/B/C/D parts. The production line is in full operation for the newer F/A-18 E/F aircraft. This obviously facilitates the ability for the FIRST program to acquire parts that are not "in-stock" more rapidly. However, the F/A-18 A/B/C/D production line has been closed for years, and some of the NAVICP DTO repairable parts may no longer have a manufacturer in the business. Therefore, NAVICP must find a suitable manufacturer on the open market to acquire replacement parts. This process is clearly more time consuming and adds significant SRT to the system as a whole. Unfortunately, for the F/A-18 E/F, support for repairable parts in the future will ultimately be the same.

## **C. CHAPTER SUMMARY**

In this chapter we have mapped out the processes and identified the minor differences between the two. We have also computed actual squadron mission capability rates for the period of study. Additionally, we computed actual MSRT rates for the Navy organic system and the Boeing FIRST system. Utilizing actual MSRT rates we then estimated the effects on overall Ao for each of the processes. We have also explained the affect of F/A-18 A/B/C/D age on our model. The analysis performed will be used to answer our research questions in Chapter V.

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## **V. CONCLUSIONS AND RECOMMENDATIONS**

### **A. CONCLUSIONS**

**1. How Does the FIRST Contract Ordering Model Compare to the Standard Navy Model for Squadrons Ordering Repairable Components?**

- The FIRST model is a mirror image of the current U.S. Navy organic model with the exception of the added step to pass requirements from NAVICP to Boeing
- The minor differences between the two processes are essentially transparent at the squadron level, the exception is the lack of Total Asset Visibility under the FIRST process

**2. What are the FIRST Contract Metrics for Delivering Repairable Components?**

- The contract requires that all repairable components be delivered within 48 hours of Boeing receiving the requirement. The four Technical Performance Measures are: Standard of Excellence (90 percent), Expected (85 percent), Threshold (75 percent) and Bound (0 to 74 percent). Each represents the percentage of the time that Boeing delivers the part within the established timeframe.
- The wholesale DTO documents in our study are required to be delivered within 48 hours according to the contract metrics. Our research indicates that Boeing's probability of delivering wholesale DTO repairable documents within the 48 hour time frame is 29 percent.

**3. Is There a Positive or Negative Impact on Overall Mission Capability Rates Under the FIRST Program?**

- Comparing the combined MC rate of 57.4 percent for the F/A-18 A-D with the combined MC rate of 66.8 percent for the F/A-18 E/F would initially suggest there is a positive impact for squadrons operating under FIRST. However, the F/A-18 A-D's average age now exceeds 10 years. During those 10 years, they have operated solely under the Navy organic system. Therefore, the 9.4 percent difference in F/A-18 E/F mission capability may or may not be relevant because the comparison is made between a brand new airframe and an aged airframe that has operated entirely under the Navy organic process.
- The FIRST squadrons mission capability rates are consistently below the Chief of Naval Operations goal of 75 percent. Furthermore, between the two F/A-18 E/F FIRST squadrons represented in our research, CNO's mission capability goals were never achieved during our period of study.

**4. Does the FIRST Program Provide Improved Operational Availability (Ao) for the F/A-18 E/F Aircraft?**

- The FIRST program clearly delivers parts faster than the standard Navy organic system. There is a clear statistical difference between the MSRT of the FIRST program and that of the Navy organic system. Placing the FIRST MSRT into the F/A-18 A-D model nets an Operational Availability increase of 8.57 percent. Additionally, placing the MSRT of the Navy organic system into the FIRST model decreases F/A-18 E/F Operational Availability by 7.69 percent. The lower Mean Supply Response Times should be expected from a brand new weapon system. Therefore, for the purposes of this study, it would only be surprising if the FIRST MSRT were close or greater than that of an older weapon system.
- As we explained in Chapter III, the formula for Operational Availability includes more components than just Supply Response Times. Unfortunately, SRT is the only objective measurable component of this contract. The subjective nature of the measurement tools for evaluating the contractor's improvements in reliability, maintainability and supportability make this question unanswerable. Therefore, it is unclear from this research how the government is effectively evaluating the contractor's performance with respect to reliability and maintainability without using quantifiable metrics.

**5. What are the Benefits/Drawbacks of the FIRST System Verses the Standard Navy Organic System?**

- The FIRST system is a replication of the standard Navy organic model. However, the program has thus far delivered repair parts faster than the standard Navy system. Our analysis verifies that FIRST MSRT rates are significantly lower for the new system. However, this may only be attributable to the production lines for the F/A-18 E/F still being in operation and the expected increase in the availability of DTO repairable parts for the new weapon system.
- The FIRST system relieves NAVSUP of its primary mission to forecast, purchase, stock and deliver wholesale replacement parts for some of the F/A-18 E/F platform.
- With the exception of SRT rates, the FIRST program lacks any quantifiable metrics to accurately measure its real effectiveness in improving Operational Availability (Ao). The contract discusses improving reliability, maintainability and parts availability while reducing total ownership costs. This thesis suggests that unless Boeing plans on completely changing hardware systems for the aircraft, reliability is already set and the design is fixed. The improvements that are discussed in the contract will only move reliability degraders from system to system and, at best, sustain the current reliability of the F/A-18 E/F design.

## **B. RECOMMENDATIONS**

Although the FIRST contract is a mirror image of the standard Navy ordering system, consideration should be given to removing the extra step of passing documents from NAVICP to Boeing. The extra step slows the process.

After comparing the Navy organic process with the FIRST process, it's unclear as to why the Navy would contract with a civilian company to replicate an established Navy system. The basic idea behind outsourcing a process is to bring dramatic change to a system that the Navy believes to be too slow, too expensive, and/or does not enhance quality or readiness. In other words, we should outsource programs that we determine are not our core logistical competencies. The thesis writers believe if you ask NAVSUP, Navy Depots, AIMD's and fleet aircraft maintenance personnel throughout the Navy what their core competencies are, you would find every single function accomplished under the FIRST contract is the core of Navy logistics. The thesis writers believe that a closer examination of the U.S. Navy logistical core competencies should be undertaken before further outsourcing of programs such as this are approved.

Upon studying the FIRST process, it is also unclear as to how the Navy will gain cost saving benefits from paying money to a civilian company to essentially duplicate their own system. If the F/A-18 E/F Programs Office believed the Navy system was essentially broken, paying a civilian company to create an identical redundant system does not appear to be a viable answer. Perhaps a study into improving our current system may have yielded better results.

The decision to outsource some of the Navy's core logistical competencies is only further complicated by using subjective measures with which to evaluate the new system. The thesis writers believe if improved reliability, maintainability and availability is the intent of the contract, then it should be thoroughly reviewed and specific measurable and quantifiable metrics be placed into the evaluation processes to reflect these goals. Furthermore, if the objectives of improved reliability and maintainability are to ultimately increase Operational Availability (Ao), then we should be accurately measuring the programs effectiveness against a quantifiable measurement of Operational Availability.

The cornerstone of the program has the misguided focus of Supply Response Time (SRT). Although important, the MSRT of a supply system has a limited effect on overall readiness. Boeing could deliver 95 percent of all parts within 30 hours but if the readiness degraders are taking 4 to 12 weeks then there will be little to no effect on overall readiness. If the F/A-18 E/F Programs Office wants improved Operational Availability (readiness) then it should focus on the other elements of Ao. Simply reviewing the Chapter III formula for Ao will reveal that even a small increase in MTBM (system reliability) will produce a higher Mission Capability (MC) rate than a much larger decrease in Supply Response Time (SRT).

**C. SUGGESTED FURTHER STUDIES**

- A cost benefit analysis for creating the FIRST program as a redundant logistical support program
- A study into the costs and long-term impacts of outsourcing the U.S. Navy's logistical core competencies
- A study into how to provide objective quantifiable metrics for evaluation factors within the F/A-18 E/F FIRST Contract

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